

CERTIFICATE

By Authority Of THE UNITED STATES OF AMERICA Legally Binding Document

By the Authority Vested By Part 5 of the United States Code § 552(a) and Part 1 of the Code of Regulations § 51 the attached document has been duly INCORPORATED BY REFERENCE and shall be considered legally binding upon all citizens and residents of the United States of America. HEED THIS NOTICE: Criminal penalties may apply for noncompliance.



Document Name: ANSI Z90.4-1984: Protective Headgear for Bicyclists

CFR Section(s): 16 CFR 1203.53(a)(1)

Date of Action: 63 FR 11712, March 10, 1998



Official Incorporator:

THE EXECUTIVE DIRECTOR
OFFICE OF THE FEDERAL REGISTER
WASHINGTON, D.C.

American National Standard

for protective headgear –
for bicyclists

ANSI Z90.4-1984



american national standards institute, inc.
1430 broadway, new york, new york 10018

ANSI®
Z90.4-1984

**American National Standard
for Protective Headgear –
for Bicyclists**

Secretariat
Snell Memorial Foundation, Inc

Approved March 12, 1984
American National Standards Institute, Inc

American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published by

American National Standards Institute
1430 Broadway, New York, New York 10018

Copyright © 1984 by American National Standards Institute, Inc
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Printed in the United States of America

A1M984/7

Foreword (This Foreword is not part of American National Standard Z90.4-1984.)

On December 9, 1960, the Sports Car Club of America requested that the American Standards Association (now American National Standards Institute, Inc) initiate a project to prepare specifications for road users' helmets. A general conference was held at the ASA headquarters in April 1961 that was attended by representatives from various consumer groups, helmet manufacturers, testing organizations, and branches of the military service including both Army and Navy. The Safety Standards Board established American National Standards Committee Z90 and charged it with the responsibility for establishing a safety code for vehicular head protection. The scope of the committee is to establish safety requirements for head protection for automobile drivers engaged in high hazard activities or occupations and for motorcyclists.

Following nearly five years of deliberations by the committee, its resulting proposals were approved by the Safety Standards Board on June 22, 1966. Subsequent experience with the specifications as originally adopted indicated a need for certain clarification and simplification. The specifications have been revised three times to incorporate the modifications deemed appropriate by the committee. The committee considered other hazardous activities and as a consequence developed this standard for recreational bicycle riders.

CAUTION: It is essential that any specific complete standard be applied or utilized only within the scope of its intended application, because there exists a great number of types of protective headgear with widely varying uses. The resulting differences in design requirements may result in very necessary compromise involving factors that include comfort, weight, visual, and auditory requirements as well as degree and extent of protection.

Suggestions for improvement of this standard will be welcome. They should be sent to the Snell Memorial Foundation, P.O. Box 733, Wakefield, RI 02880.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Vehicular Head Protection, Z90. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard the Z90 Committee had the following members:

George G. Snively,* Chairman

<i>Organization Represented</i>	<i>Name of Representative</i>
American Association for Automotive Medicine	George G. Snively*
American Medical Association.	H. A. Fenner, Jr
American Power Boat Association	John Langley
American Sports Company	Victor J. Padilla
Ballen Helmet Company	Harold Ballen
Bell Helmets, Inc	Dean Fisher
California Association of Bicycling Organizations.	Alan Wachtel
California Highway Patrol	Hal Eldridge
Hanna-Pro Enterprises	Harold Stock
Mountain Safety Research	Ted McCoy
National Bureau of Standards	Nick Calvano
Safety Helmet Council of America	Ivan J. Wagar
Skid-Lid Manufacturing Company	R. Kevin Montgomery
Snell Memorial Foundation, Inc	C. O. Chichester†
Sports Car Club of America	George G. Snively*
U.S. Air Force Logistics Command	William C. Chilcott
U.S. Army, Aeromedical.	Joseph Haley
U.S. Army, Quartermaster Research Command.	Bruce Buckland
U.S. Naval Aviation.	Channing L. Ewing
Washington Area Bicycle Association.	Randolph Swart

Independent Experts

George R. Henderson	A. L. Lastnik
Harry Hurt	James H. McElhaney
A. Marshall Irving	Verne Roberts
Arthur James	

*Deceased.

†Present Chairman.

Contents

SECTION	PAGE
1. Scope, Purpose, and Requirements	7
1.1 Scope	7
1.2 Purpose	7
1.3 Requirements	7
2. Referenced Standards	7
3. Definitions	7
4. Construction	10
4.1 General	10
4.2 Projections	10
5. Materials	10
6. Marking	11
7. Samples for Testing	11
7.1 Condition and Attachments	11
7.2 Number of Samples	11
8. Test Schedule	11
9. Conditioning Environments	11
9.1 Ambient Conditions	11
9.2 Low Temperature	11
9.3 High Temperature	11
9.4 Water Immersion	11
10. Extent of Protection	11
11. Peripheral Vision	11
12. Tests of Impact Energy Attenuation	12
12.1 Measurement of Impact Energy Attenuation	12
12.2 Acceptable Acceleration Levels	12
12.3 Impact Sites	12
13. Test of Retention System Strength	12
13.1 Dynamic Test Description	12
13.2 Apparatus	12
13.3 Procedure	12
13.4 Interpretation of Results	12
14. Requirements for Test Equipment	12
14.1 Equipment and Environment	12
14.2 Instrumentation Check	15
14.3 Velocity-Sensing System	15
15. Reference Marking	15
16. Records of Tests	15
17. Test Headforms	15
17.1 General	15
17.2 Material of Headforms	15
17.3 Mass of Headforms	15
Tables	
Table 1 Polar Coordinates of Horizontal Half-Sections	8
Table 2 Reference Marking Dimensions	13

SECTION	PAGE
Figures	
Figure 1 Typical Headform.	7
Figure 2 Extent of Protection and Clearance for Goggles	9
Figure 3 Headform Elevation	9
Figure 4 Horizontal Half-Sections at Datum Levels	10
Figure 5 Apparatus for Tests for Impact Energy Attenuation	13
Figure 6 Apparatus for Test for Retention System Strength	14

American National Standard for Protective Headgear – for Bicyclists

1. Scope, Purpose, and Requirements

1.1 Scope. This standard specifies minimum performance criteria and describes test methods for protective headgear for wear by bicyclists.

1.2 Purpose. The purpose of this standard is to provide bicyclists with minimum acceptable levels of head protection, acknowledging the desirability of light weight and ventilation.

1.3 Requirements. Tests of the protective-headgear assembly shall be conducted to ensure compliance, under specific environmental conditions, with the requirements in this standard for:

- (1) Impact attenuation properties of the protective headgear
- (2) Adequacy of the strength of the retention system

2. Referenced Standards

This standard is intended for use in conjunction with the following standards:

ISO/DIS 6220-1983, Headforms for Use in the Testing of Protective Helmets¹

SAE J211-JUN80, Instrumentation for Impact Tests²

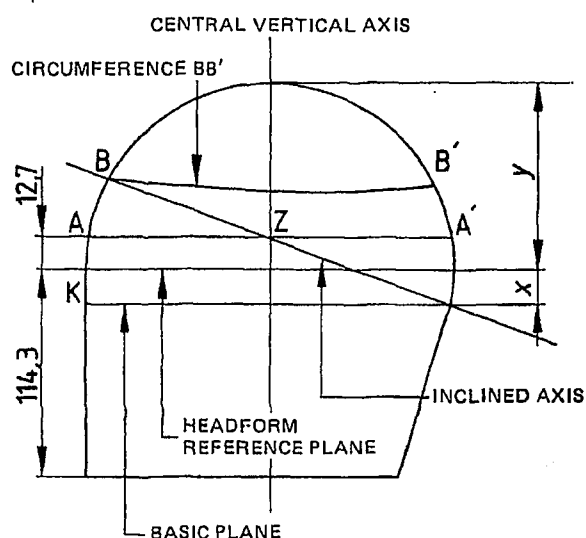
3. Definitions

3.1 Basic Plane. A plane at the level of the external auditory meatus (external ear opening) and the inferior margin of the orbit (lower edge of the eye socket). (See Figure 1.)

3.2 Midsagittal Plane. A longitudinal plane passing through the vertex of the headform, perpendicular to

¹ Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

² Available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.



NOTE: All dimensions are in millimeters.

Headform Size	x	y
A	24	90
E	26	96
J	27	103
M	29	107

Figure 1
Typical Headform

the basic plane, that geometrically bisects the headform. (See Figure 2.)

3.3 Reference Plane. A plane at a given distance above and parallel to the basic plane. (See Figure 1.)

3.4 Reference Headform. A measuring device contoured to the dimensions of one of the four headforms described in Figures 3 and 4, with surface markings indicating the locations of the basic, midsagittal, and reference planes and the centers of the external ear openings.

Table 1
Polar Coordinates of Horizontal Half-Sections

Headform Size A: Dimension $y = 90$ mm													
Height above reference plane	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	88,0	86,5	83,0	75,5	70,0	67,0	66,5	69,5	73,5	78,5	84,0	87,0	88,0
20	85,5	84,5	82,5	75,5	70,0	67,0	66,5	69,5	73,5	78,5	84,0	87,0	87,0
40	80,0	79,5	79,0	72,0	67,5	65,0	64,5	67,0	71,0	76,0	80,5	82,0	81,5
50	75,0	75,0	74,5	68,5	63,5	61,0	60,5	63,5	67,0	72,0	76,0	77,0	77,0
60	68,0	68,0	67,5	62,5	57,5	55,5	55,0	58,0	61,5	66,0	70,0	70,0	70,5
70	56,0	56,0	56,5	53,0	49,5	47,0	47,0	49,0	53,0	57,0	61,5	61,0	61,0
80	37,0	37,5	37,0	36,5	35,5	34,0	34,0	36,0	39,5	44,5	49,0	49,0	48,5
85	23,0	24,0	23,0	22,0	22,0	23,0	24,0	24,5	29,5	33,5	36,0	36,5	37,0

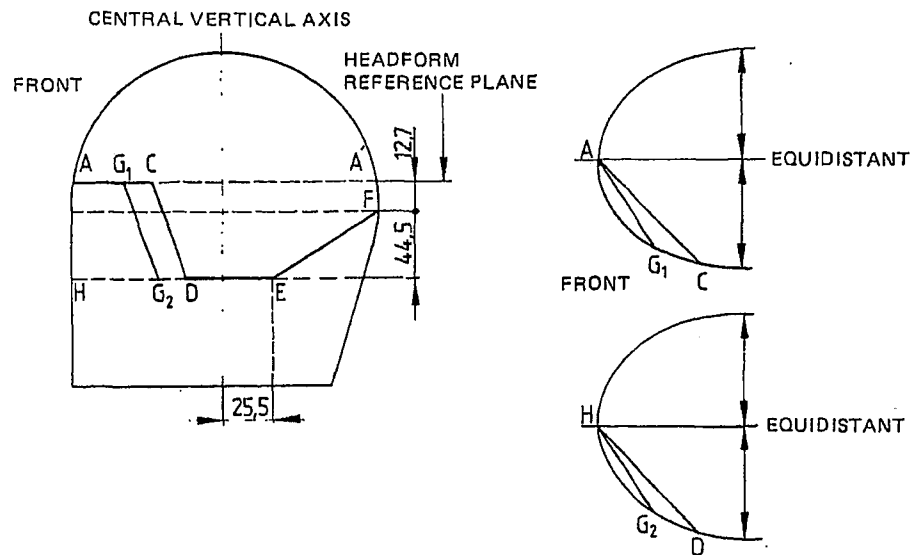
Headform Size E: Dimension $y = 96$ mm													
Height above reference plane	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	94,5	93,0	90,0	82,0	76,5	73,5	73,0	76,0	80,0	85,0	91,0	94,0	94,5
20	92,5	91,5	89,0	82,0	76,5	73,5	73,0	76,0	80,0	85,0	90,5	93,5	94,0
40	87,0	87,5	85,0	79,5	74,5	71,0	71,5	74,0	77,5	82,5	88,0	89,0	89,0
50	82,5	83,0	81,0	76,0	71,0	68,0	68,0	70,5	74,0	79,5	83,5	84,5	84,5
60	76,5	76,5	76,5	71,0	68,5	63,5	63,5	66,0	69,5	74,0	78,5	79,0	79,0
70	66,5	66,5	66,5	63,0	59,0	58,5	56,5	58,5	62,0	66,5	70,5	71,0	71,0
80	52,0	52,0	52,0	50,0	47,5	46,0	46,5	48,0	51,0	56,0	59,5	60,0	60,0
85	41,5	41,5	41,5	40,5	39,5	39,0	39,5	41,0	44,0	48,0	51,5	52,0	52,0
90	28,0	28,0	28,5	28,5	28,5	29,0	30,0	31,0	34,0	37,5	41,5	42,0	42,0
95	10,0	10,0	10,0	10,0	10,0	10,5	11,0	12,0	13,5	15,0	16,0	16,0	16,0

Headform Size J: Dimension $y = 103$ mm													
Height above reference plane	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	101,0	99,5	95,5	87,5	82,5	79,5	79,5	82,0	86,0	92,0	97,0	100,5	101,0
20	99,0	97,0	93,5	87,5	82,0	79,5	79,5	82,0	86,0	92,0	96,5	99,5	100,0
40	93,0	92,5	90,0	85,5	80,0	77,5	77,5	80,5	84,0	89,0	93,0	95,5	95,5
50	90,0	89,0	87,0	83,0	77,0	74,5	75,0	77,5	81,0	86,0	90,0	91,5	91,5
60	84,0	83,0	81,5	77,0	73,0	70,0	71,0	73,0	77,0	81,0	85,5	87,0	87,0
70	76,0	75,5	74,0	71,0	67,0	65,0	65,5	67,0	71,5	76,0	79,0	80,0	80,0
80	65,0	65,0	64,0	61,0	58,5	56,0	57,0	59,0	62,5	66,5	69,5	71,0	71,0
85	58,0	58,0	56,5	54,5	52,0	50,0	51,0	52,5	56,5	60,5	64,5	65,0	65,0
90	48,5	48,0	47,0	45,5	43,5	43,0	44,0	46,0	49,5	54,0	57,0	58,5	58,5
95	37,0	36,5	35,0	34,0	33,0	33,5	34,5	36,0	39,0	43,0	46,5	47,0	47,0
100	20,0	20,0	19,5	19,0	18,5	18,5	19,0	20,5	23,5	27,5	31,0	31,5	31,0

Headform Size M: Dimension $y = 107$ mm													
Height above reference plane	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	106,0	104,0	101,0	93,5	87,0	84,5	84,0	86,5	91,0	96,0	102,0	106,0	106,0
20	103,5	102,5	99,5	93,0	87,0	84,5	84,0	86,5	91,0	96,0	101,5	105,5	105,5
40	99,0	98,5	96,5	90,5	85,0	82,5	82,0	84,0	88,5	93,5	98,0	100,5	100,5
50	95,5	94,5	93,0	87,5	82,0	79,5	79,0	81,5	85,5	90,0	93,0	97,0	97,0
60	89,5	89,5	88,0	83,0	77,5	75,0	75,0	77,0	81,5	86,5	91,0	92,0	92,0
70	82,0	82,0	81,0	77,0	72,0	69,5	69,5	71,5	75,5	81,0	84,0	85,5	85,5
80	71,5	71,5	71,0	68,0	64,0	61,5	61,5	64,0	67,0	72,0	76,0	77,0	77,0
85	64,5	64,5	64,0	61,5	59,0	57,0	57,0	58,5	61,5	66,5	71,0	72,0	72,0
90	56,5	56,5	56,5	55,0	53,0	51,5	51,5	53,0	56,0	60,5	64,5	66,0	66,0
95	46,5	46,5	47,0	46,5	45,5	44,0	44,0	45,5	48,5	53,0	57,5	59,0	58,5
100	32,0	32,0	32,5	33,0	34,0	34,0	34,5	35,5	38,5	43,0	46,5	48,5	48,0
105	12,0	12,0	13,0	14,0	15,0	16,0	17,5	19,5	21,0	25,0	29,5	30,0	30,0

NOTE: All dimensions are in millimeters.

8

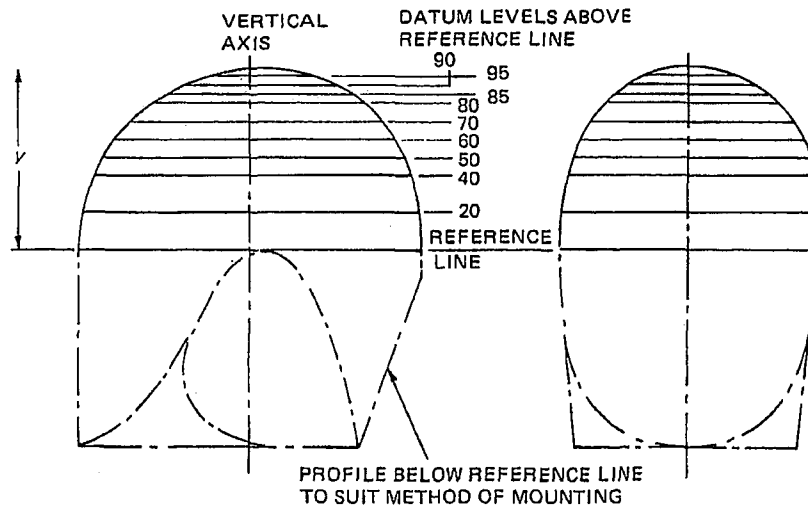


NOTES

- (1) All dimensions are in millimeters.
- (2) The dimensions in the table are the lengths of the cords measured with the aid of dividers.

Headform Size	AG ₁	AC	HG ₂	HD
A	72	79	88	95
E	77	84	94	101
J	80	88	97	104
M	82	90	100	107

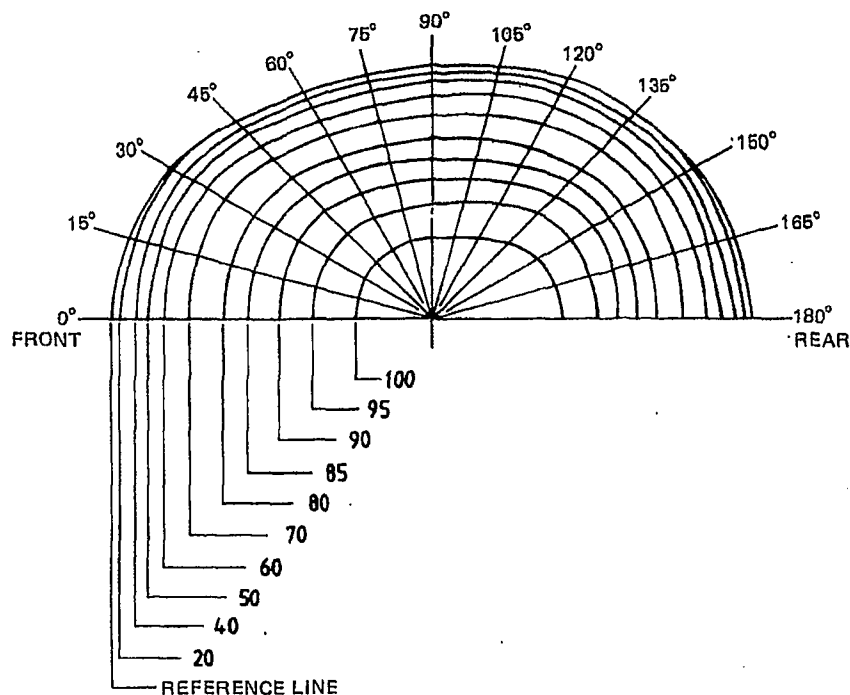
Figure 2
Extent of Protection and Clearance for Goggles



NOTES:

- (1) All dimensions are in millimeters.
- (2) For dimension *y* see Table 1.

Figure 3
Headform Elevation

**NOTES**

- (1) All dimensions are in millimeters.
- (2) For polar coordinates of horizontal sections see Table 1.

Figure 4
Horizontal Half-Sections at Datum Levels

3.5 Test Headform. A test device contoured to the dimensions of the four headforms described in Figures 3 and 4 and Table 1 for all surface areas that contact the helmet, with surface markings indicating the locations of the basic, midsagittal, and reference planes. Headforms shall be as defined in ISO/DIS 6220-1983.

3.6 Retention System. The complete assembly that maintains the protective headgear in a stabilized position on the wearer's head.

3.7 Projection. Any part of the protective headgear, internally or externally, that juts out or extends beyond the surface in an abrupt fashion.

3.8 Positioning Index. The distance from the lowest point of the brow at the lateral midpoint of the helmet to the basic plane of a reference headform at which the helmet is considered firmly and properly positioned on the reference headform.

3.9 Bicyclist. A bicyclist is a person operating a people-powered surface vehicle with one or more wheels.

3.10 Shell. The outer surface of the protective device.

4. Construction

4.1 General. The helmet shall be constructed to absorb impact energy and to provide a retention system.

4.2 Projections. There shall be no permanent external projections greater than 5 mm above the outer surface of the shell. Rivet heads shall be radiused and shall not project more than 2 mm above the outer surface of the shell. There shall be no inward-facing sharp edges on the inside of the helmet. Rigid internal projections shall be covered with padding.

5. Materials

The characteristics of the materials used in the manufacture of helmets shall not undergo appreciable alteration due to aging or normal use, such as exposure to sun, extremes of temperature, and rain.

If hydrocarbons, cleaning fluids, paints, or transfers and other additions will affect the helmet adversely, a warning shall be provided.

The materials used for those parts of the helmet coming into contact with the skin shall not undergo appreciable alteration because of sweat or of toiletries. Materials that cause skin disorders shall not be used.

6. Marking

Bicyclist's headgear offered for sale shall have permanent and legible marking that will give traceability, identification of the manufacturer, date of manufacture, and size. The headgear shall be labeled with the following instructions:

- (1) "This helmet is designed only for bicycle use."
- (2) "No helmet can protect the wearer against all foreseeable impacts. However, for maximum protection, the helmet must be of good fit and all retention straps must be securely fastened."
- (3) "This helmet is so constructed that the energy of an impact may be absorbed through partial destruction of the headgear, though damage may not be visible to the naked eye. If it suffers such an impact, it should either be returned to the manufacturer for competent inspection or destroyed and replaced."
- (4) "This helmet can be seriously damaged by some common substances without visible damage. Apply only the following: (Recommended cleaning agents, paints, adhesives, and the like) as appropriate."

7. Samples for Testing

7.1 Condition and Attachments. For all testing, protective headgear shall be tested in the condition as offered for sale. Attachments shall not be installed on the helmet during testing.

7.2 Number of Samples. Four samples for each available headform size are required for testing. Each test sample, following exposure to the environmental condition specific to it (described in Section 9) shall be subjected to the tests described in Section 8.

8. Test Schedule

For each set of four samples:

- (1) Each helmet shall be examined for extent of protection (see Section 10) and peripheral vision (see Section 11).
- (2) Each helmet shall be conditioned to one of the environments specified in 9.1, 9.2, 9.3, or 9.4 as required by the test sequence for impact energy attenuation given in 12.3.1.

- (3) Each helmet shall be subjected to the tests for impact energy attenuation and retention system strength as described in Sections 12 and 13, respectively.

Testing shall begin immediately after removal from the conditioning equipment. The maximum time during which the protective headgear may be out of the conditioning environment shall not exceed 5 minutes. The helmet shall then be returned to the conditioning environment for a minimum of 15 minutes before again being withdrawn. This process shall be continued until a specific item has been put through all necessary testing.

9. Conditioning Environments

9.1 Ambient Conditions. The first protective headgear shall be conditioned in the environment defined in 14.1 for a period of not less than 4 hours.

9.2 Low Temperature. The second protective headgear shall be conditioned by being exposed to a temperature of $-10^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for not less than 4 hours in a controlled environmental temperature apparatus.

9.3 High Temperature. The third protective headgear shall be conditioned by being exposed to an air temperature of $50^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for a period of not less than 4 hours in a circulating air oven.

9.4 Water Immersion. The fourth protective headgear shall be immersed in water at a temperature of 18°C to 27°C for a period of not less than 4 hours.

10. Extent of Protection

The entire area of the headgear above the test line stipulated in 15.1 shall attenuate impact energy to the minimum requirements specified in 12.2 and 12.3.

11. Peripheral Vision

The helmet shall provide peripheral vision clearance of a minimum of 105 degrees horizontally to each side of the midsagittal plane through the point K (see Figure 1). This angle shall be measured while the helmet is mounted on the smallest headform appropriate to the size range of the helmet.

12. Tests of Impact Energy Attenuation

12.1 Measurement of Impact Energy Attenuation. Impact energy attenuation shall be measured by determining imparted acceleration to an appropriately instrumented standard test headform specified in Section 17. The subject protective headgear shall be placed on the headform and the assembly shall be dropped in a guided fall, vertical within 13 mm per 5.0 meters of height, onto a steel anvil fixed on a rigid base. (See Figure 5.)

12.2 Acceptable Acceleration Levels. The peak acceleration, as measured by the instrumented test headform, resulting from the impacts delivered to each of the four preconditioned protective headgear, shall not exceed 300 units of gravity (G 's).

12.3 Impact Sites

12.3.1 Each helmet shall be impacted once at each of four sites onto a flat steel anvil and a hemispherical steel anvil as specified in 12.3.5 and 12.3.6. The impact sites shall be placed at any point on the area above the test line described in 15.1 and separated by a distance not less than one-fifth of the maximum circumference of the helmet. If there are mechanical fasteners in the test area, at least one shall be impacted. At least one impact shall be 12 mm above the test line at the front, rear, or side of helmet. In each test series, impacts shall be equally divided between flat and hemispherical anvils.

12.3.2 The heights of the guided-free-fall drop for the helmet and test headform combination onto the hemispherical anvil and flat anvil shall be at least 1.0 meter and achieve an impact velocity of $4.57 \text{ m/s} \pm 0\%$, -5% .

12.3.3 The weight of the drop assembly, as specified in Table 2, shall be the combined weight of the instrumented test headform and supporting assembly for the drop test. The weight of the supporting assembly shall not exceed 25% of the weight of the drop assembly. The center of gravity of the combined test headform and supporting assembly shall lie within a cone having its axis vertical and forming a 10° included angle with the vertex as the point of impact.

12.3.4 The acceleration transducer shall be mounted at the center of gravity of the combined test headform and supporting assembly with the sensitive axis aligned to within 5° of the vertical when the test headform is in the impact position. The acceleration data channel shall comply with the requirements in SAE J211-JUN80 for channel Class 1000.

12.3.5 The flat anvil shall be constructed of steel with an impact face having a minimum diameter of 125 mm. The hemispherical anvil shall be constructed of steel with an impact face having a radius of 50 mm.

12.3.6 The rigid mount for both of the anvils shall consist of a solid mass of at least 135 kg, the upper surface of which shall consist of a steel plate with a minimum thickness of 25 mm and minimum surface area of 0.3 m^2 .

12.3.7 Impact velocity shall be measured during each test and shall be within the limits specified in 12.3.2. This measurement shall correlate with pretest and posttest G calibration of the drop system as specified in 13.1.1.

13. Test of Retention System Strength

13.1 Dynamic Test Description. The dynamic test of the retention system shall be conducted by delivering a 19.6 J impact to the retention system by dropping a mass of 2 kg a distance of 1 meter. (See Figure 6 for a typical test apparatus.)

13.2 Apparatus. The test apparatus shall provide for a 1-meter drop of a cylindrical mass that has, along its axis, a hole of sufficient diameter to allow it to fit around a steel rod that is square or circular with a diameter of 12 to 15 mm. The rod shall have a steel end stop and a minimum length of 1 meter plus the height of the cylinder. The mass of the entire loading apparatus excluding the 2-kg cylindrical mass shall be $1.5 \text{ kg} \pm 0.1 \text{ kg}$.

13.3 Procedure. The helmet shall be placed on the headform. The retention system shall be secured through rollers so that the entire dynamic test apparatus hangs freely on this retention system. The strap of the retention system shall be fastened under a stirrup that approximately conforms to the shape of the bone structure of the lower jaw. This stirrup shall consist of two metal rollers each with a diameter of $12.5 \text{ mm} \pm 0.5 \text{ mm}$ that have a center separation of $76.0 \text{ mm} \pm 0.5 \text{ mm}$. Then the 2-kg mass shall be raised 1 meter and allowed to fall freely against the rigid end stop.

13.4 Interpretation of Results. When tested the retention system shall not fail. The system shall remain intact so that the loading device does not become detached from the retention system. Maximum elongation of the retention system shall not exceed 25 mm.

14. Requirements for Test Equipment

14.1 Equipment and Environment. Prior to testing, all equipment shall be turned on and allowed to warm up for at least 30 minutes or until equilibrium is reached, whichever time is greater.

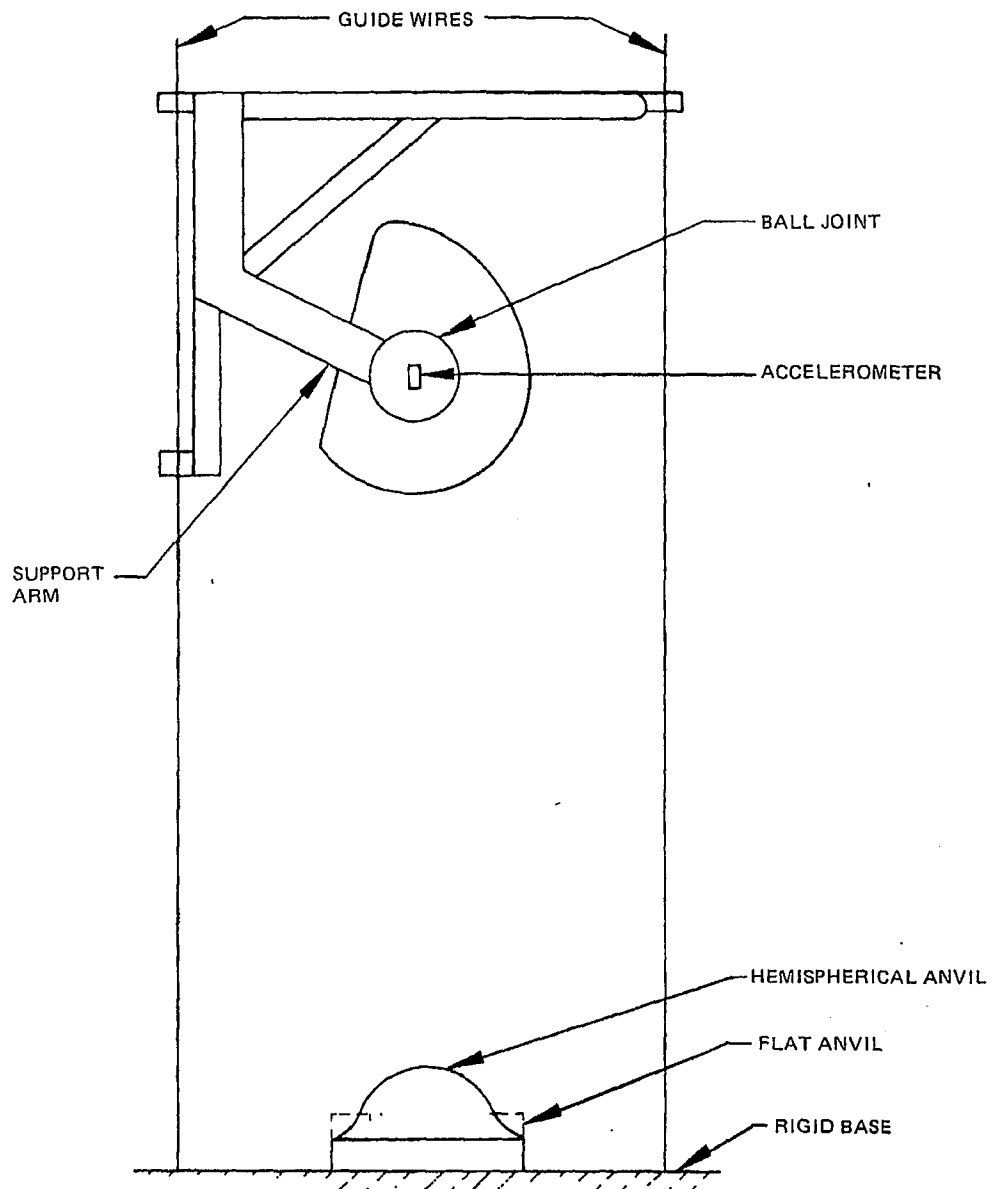


Figure 5
Apparatus for Tests for Impact Energy Attenuation

Table 2
Reference Marking Dimensions

Headform Size	h	a	i	b	f
A	55	29.3	30	29.3	5
E	55	31.5	30	31.5	5
J	58	33.7	33	33.7	8
M	60	35.3	35	35.3	10

NOTE: All dimensions are in millimeters.

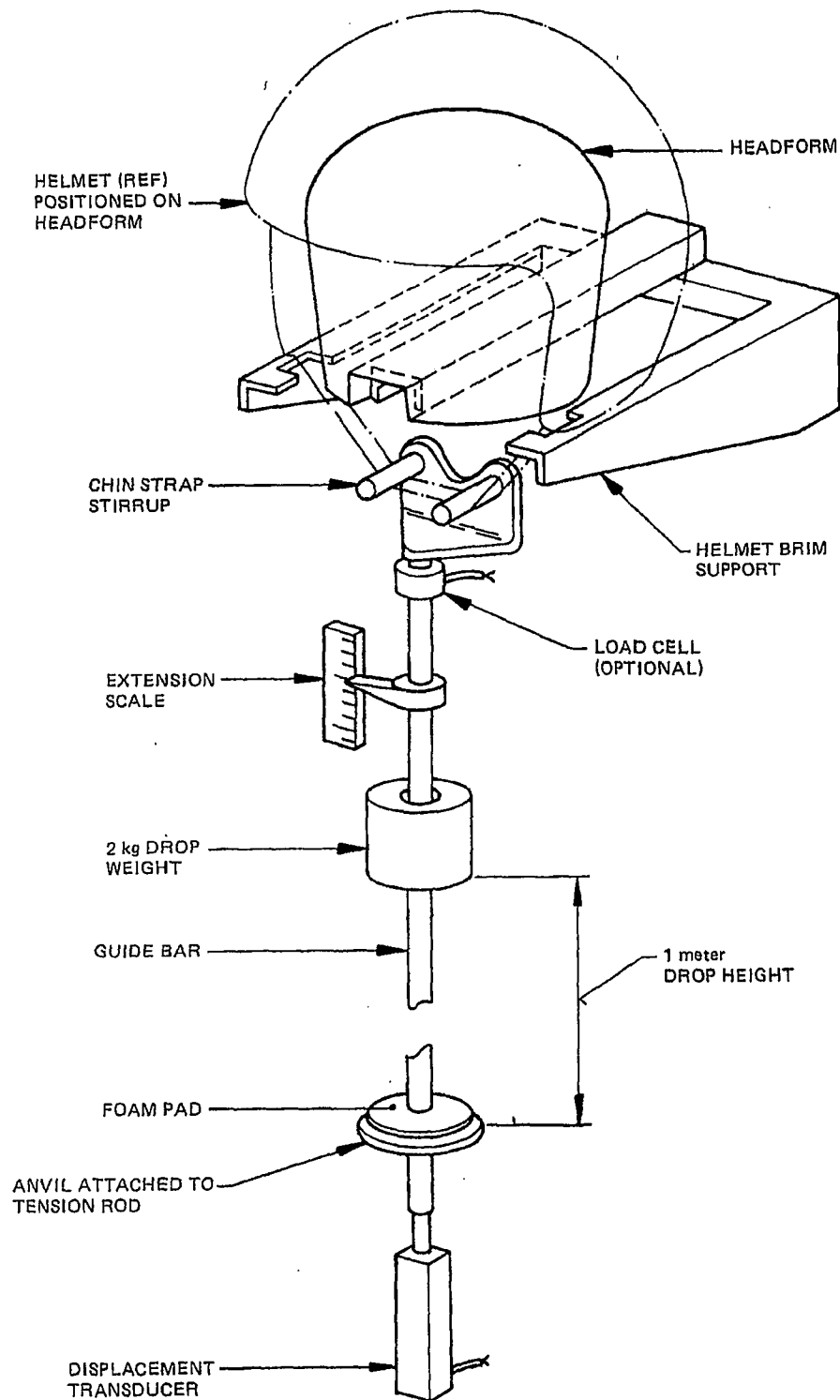


Figure 6
Apparatus for Test for Retention System Strength

The following environmental conditions shall be maintained throughout the period of calibration and testing:

Relative humidity: 20%-80%
Temperature: 18°C-27°C

14.2 Instrumentation Check. The entire instrumentation system shall be checked before and after each series of tests by impacting a standard calibrating medium capable of producing an acceleration-time history of 400 G's, and a time duration of at least 1 ms, at 200 G's. At least three such impacts shall be recorded before and after testing and made part of the test report. If the posttest average of the three impacts differs from the pretest average by more than 5%, the entire test series shall be discarded.

Periodically it shall be demonstrated that the average peak acceleration of three impacts of the headform on a standard calibrating medium has not drifted more than $\pm 5\%$ since the last independent calibration of the instrumentation traceable to the National Bureau of Standards (NBS).

In addition to the above calibration, the velocity of free fall shall be measured at a point within the last 25 mm of travel prior to headform-calibration medium contact. This value shall be used to correlate calibration with velocity values measured during each headgear impact test.

14.3 Velocity-Sensing System. The velocity-sensing system shall include an appropriate transducer that will produce a discrete output resolvable within 200 microseconds.

15. Reference Marking

15.1 A reference headform that is firmly seated with the basic plane horizontal shall be used for reference marking. The complete helmet to be tested shall be placed on the applicable reference headform whose circumference is not greater than the internal circumference of the headband when adjusted to its largest setting, or, if no headband is provided, to the corresponding interior surface of the helmet.

A static force of 50 newtons (N) shall be applied normal to the apex of the helmet. The helmet shall be centered laterally and seated firmly on the applicable reference headform according to its helmet-positioning index.

Maintaining the force and position described above, a test line shall be drawn on the outer surface of the helmet coinciding with portions of the intersection of that surface of the helmet with the following planes:

(1) A plane h mm above and parallel to the reference plane in the anterior portion of the reference headform;

(2) A vertical transverse plane a mm in front of the external ear opening in a side view;

(3) A plane i mm above and parallel to the reference plane of the reference headform;

(4) A vertical transverse plane b mm behind the center of the external ear opening in a side view; and

(5) A plane j mm above and parallel to the reference plane in the posterior portion of the reference headform.

For the dimensions to be used for the different headform sizes, see Table 2.

15.2 Prior to each test, fix the helmet on a test headform in the position that conforms to its helmet-positioning index. The helmet shall be secured so that it does not shift position prior to impact or to application of force during testing.

In testing as specified in Section 12, the retention system shall be positioned so that it does not interfere with free fall or impact.

16. Records of Tests

A permanent record of each test shall be retained consisting of a record of each impact, showing calibration of time and G scales. A photograph of the acceleration-time curve taken from suitable oscillographic or oscilloscope equipment can be used as a minimum record.

17. Test Headforms

17.1 General. Only that part of a headform above the reference plane shall be designed to represent the human head. Below the reference plane, the profile may vary to suit the method of mounting. In all sizes of headform, the inclined axis passes through a point Z on the central vertical axis, 12.7 mm above the reference plane. This point shall be taken as the center of gravity of the human head (see Figure 1). Headforms used in the tests shall comply with the details specified in Figures 3 and 4. The sizes used shall be A, E, J, and M as defined in Table 2.

17.2 Material of Headforms. Headforms shall be made of low-resonant-frequency material and shall exhibit no resonant frequencies below 3000 Hz.

17.3 Mass of Headforms. The mass of each headform shall be such that the headform, together with the supporting assembly, weighs $5 \text{ kg} \pm 0.05 \text{ kg}$.

Ready Access to the World's Standards through ANSI

Are you seeking a standard vital to your interests? Turn to the American National Standards Institute, which performs a unique function as America's clearinghouse and information center for national, international, regional, and foreign standards.

ANSI is the sole source of *all* approved American National Standards. In addition, the Institute is the U.S. source for all international standards and drafts of the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), and of the publications of ISO member bodies. And that's not all . . .

Here's a capsule summary of the wealth of materials available from ANSI —

STANDARDS

- *All approved American National Standards in print. A standing order service is available to standards users who wish to receive new and revised standards automatically.*
- *ISO and IEC International Standards*
- *ISO Draft International Standards*
- *IEC Six Months' Rule Drafts*
- *CEN Proposals — Draft European Standards developed and issued for preliminary vote by the European Committee for Standardization (CEN).*
- *CENELEC/CECC Proposals — Draft specifications issued by CECC, the Electronic Components Committee of the European Committee for Electrotechnical Standardization (CENELEC)*
- *Standards of 89 national standards organizations that belong to ISO*
- *English translations of thousands of foreign standards*

CATALOGS

- *Annual Catalog of American National Standards. Supplements are published several times a year.*
- *Latest catalogs issued by ISO, IEC, and 55 members of ISO*
- *Foreign catalogs in English translation*
- *Specialized listings of American National Standards in fields ranging from information processing to safety and health*

Available in Microform

American National Standards are available in microform from: Information Handling Services, Inverness Business Park, 15 Inverness Way East, P.O. Box 1154, Englewood, Colorado 80110; tel (303) 779-0600; and from Information Marketing, Inc, 13251 Northend Street, Oak Park, Michigan 48237; tel (313) 546-6706. All ISO and IEC standards may be obtained in microform from Information Handling Services.



2

3



4

5



American National Standards

The standard in this booklet is one of 8000 standards approved to date by the American National Standards Institute.

The Standards Institute provides the machinery for creating voluntary standards. It serves to eliminate duplication of standards activities and to weld conflicting standards into single, nationally accepted standards under the designation "American National Standards."

Each standard represents general agreement among maker, seller, and user groups as to the best current practice with regard to some specific problem. Thus the completed standards cut across the whole fabric of production, distribution, and consumption of goods and services. American National Standards, by reason of Institute procedures, reflect a national consensus of manufacturers, consumers, and scientific, technical, and professional organizations, and governmental agencies. The completed standards are used widely by industry and commerce and often by municipal, state, and federal governments.

The Standards Institute, under whose auspices this work is being done, is the United States clearinghouse and coordinating body for voluntary standards activity on the national level. It is a federation of trade associations, technical societies, professional groups, and consumer organizations. Some 1000 companies are affiliated with the Institute as company members.

The American National Standards Institute is the United States member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Through these channels U.S. standards interests make their positions felt on the international level. American National Standards are on file in the libraries of the national standards bodies of more than 60 countries.

American National Standards Institute, Inc
1430 Broadway
New York, N.Y. 10018